REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
31-03-2007	Final Technical Report	01-APR-02 THROUGH 31-MAR-07

4. TITLE AND SUBTITLE
Nearshore Canyon Experiment

5a. CONTRACT NUMBER

5b. GRANT NUMBER
N00014-02-1-0415

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
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5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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8. PERFORMING ORGANIZATION REPORT NUMBER

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875 N. Randolph Street
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Arlington, VA 22203-1995

10. SPONSOR/MONITOR'S ACRONYM(S)
ONR

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The objective of the Nearshore Canyon Experiment (NCEX) was to understand the effect of complex continental-shelf bathymetry on surface gravity waves and on the breaking-wave-driven circulation onshore of the irregular bathymetry.

The NCEX observations were the first extensive quantitative field measurements of the effect of severe alongshore bathymetric inhomogeneities (here a submarine canyon) on incident waves, and on the surfzone circulation.

15. SUBJECT TERMS
Waves, surfzone, circulation.

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Robert T. Guza
Unrestricted	Unrestricted	Unrestricted	None	4	19b. TELEPHONE NUMBER *(Include area code)* (858) 534-0585

Nearshore Canyon Experiment
ONR Grant No. N00014-02-1-0415
April 1, 2002 through March 31, 2007
Robert T. Guza, PI

Over 100 sensors were deployed offshore, near, and onshore of two submarine canyons. In addition, bathymetric surveys extending from above the shoreline to about 8-m water depth were conducted almost weekly along several km of the coast.

A wide range of wave conditions was observed, including 2-m high offshore waves, and cross- and alongshore surfzone mean currents exceeding 40 and 75 cm/s, respectively. In addition, bathymetric surveys extending from above the shoreline to about 8-m water depth were conducted almost weekly along several km of the coast.

During the last year, a data set of quality controlled surfzone observations was made available to the public on the WWW (http://science.whoi.edu/users/elgar/NCEX). The data base includes time series of pressures and velocity, as well as data products such as wave heights, wave directions, wave-orbital velocities, and mean currents. NCEX observations are being used in collaboration with modeling studies and as ground truth for remote sensing of nearshore waves and currents. More than 20 researchers (from US universities, Navy laboratories, and American engineering companies, as well as from European institutions) have downloaded data from the NCEX data distribution site in 2006.

NCEX included observations of waves and currents between the shoreline and about 30 m depth. Analysis of NCEX observations seaward of the surf zone, led by Drs Herbers and O'Reilly, has resulted in several journal articles comparing observed and modeled waves.

The surfzone observations, collected with co-PIs Elgar and Raubenheimer, are being used in our studies of surfzone processes. These studies include analysis of previously collected observations.

Infragravity energy levels observed in bottom-pressure records and seismic sensors deployed on the continental shelf are strongly modulated at tidal periods. Recently graduated MIT-WHOI Joint Program student Dr. Jim Thomson used observations from NCEX to demonstrate that the observed tidal modulations of infragravity energy are caused by differences in nonlinear interactions between these low frequency long waves and higher frequency swell in the surfzone as the beach slope changes with the rising and falling tide. In particular, on many beaches the low tide beach profile is convex, and the high tide profile is concave, and thus waves are in shallow water over a longer distance at low tide than at high tide (Thomson et al. 2006). Nonlinear interactions that transfer energy from long waves to swell are stronger in shallow water, and thus more energy is transferred at low than at high tide. The energy transfer results in an apparent dissipation of the low frequency long waves. The tidal difference in energy transfer causes there to

be less energy available to reflect from the shoreline at low tide, and thus offshore energy levels change with the tide. The discovery that the observed energy loss is the result of nonlinear interactions, rather than owing to dissipative processes, such as turbulence generation, is a new finding (Thomson et al., 2006, Henderson et al. 2006).

Including the effect of bottom stress leads to improved skill in models that predict wave-induced setup, especially near the shoreline. The effects of rollers on setup were shown to be small (Apotsos et al., in press).

Ongoing analysis of surfzone circulation, with postdoctoral investigator Steve Hendersen, is based on the vertically integrated, wave averaged, nonlinear shallow water equations.

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